COMPLETE ENGLISH TRANSLATION OF JP9-161284

[Title of the Invention] FOCUS SETTING METHOD AND OPTICAL DISK DRIVING DEVICE

(57)[Abstract]

[Object] To provide a method of setting a focus by which data can be accessed in a short time in a two-layer optical disk driving device, and provide an optical disk driving device having the method of setting a focus.

[Solving Means] The method comprises confirming the passing of a first layer of a focus point by a focus error signal from the first layer, and then turning ON a focus servo. The composition allows the passing of the first layer to be confirmed by the focus error signal of the first layer, and thus allows the focus servo of a second layer to be started directly by the focus error signal of the second layer without starting the focus servo of the first layer. As a result, there can be obtained the method of setting a focus by which a time required until the data read of the second layer is shortened, and the optical disk driving device.

[Claims]

[Claim 1] A method of setting a focus of an optical disk comprising a disk rotating step of rotating a two-layer optical disk in which an optical pit having recording information is provided on the two layers, a surface layer side and an inner layer side thereof by a spindle motor; an information reading step of focusing a laser beam on said two-layer optical disk by a pick up to reproduce the recorded information; and a servo controlling step of performing the servo control of a focus of said pick up on the basis of an output of said information reading step and of performing the servo control of a revolution speed of said spindle motor, characterized in that:

said servo controlling step is performed such that after said information reading step detects that a focus point has passed a first layer, the servo control of said focus is turned ON.

[Claim 2] An optical disk driving device comprising a two-layer optical disk in which an optical pit having recording information is provided on the two layers, a surface layer side and an inner layer side thereof; a spindle motor of rotating said two-layer optical disk; a pick up of focusing a laser beam on said two-layer optical disk to reproduce the recorded information and output the information as an RF signal; an RF signal amplifying means of amplifying said RF signal; a servo means of performing the servo control of said focus on the basis

of an output of said RF signal amplifying means and of performing the servo control of a revolution speed of said spindle motor; and a controlling means of controlling the entire of the optical disk driving device, characterized in that:

said controlling means is performed such that after said pick up detects that a focus point has passed a first layer, the servo control of said focus is turned ON.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to a method of setting a focus which is more effective with respect to a second layer, and to the optical disk driving device, in an optical disk driving device of driving a two-layer optical disk.

[0002]

[Prior Art] Recently, with the development of the large-capacity technology of optical disks, the structure of optical disks has been provided not only of single layer but also of two layers. Hereinafter, there will be explained a method of setting a focus in such two-layer optical disks.

[0003] Fig. 5 is a flowchart showing a method of setting a focus in a conventional two-layer optical disk; Fig. 6 is a diagram showing a timing wave form of a focus error signal: and Fig. 7 is a diagram showing a relationship in position between an optical disk and an objective lens when a focus is set in a

conventional two-layer optical disk. In the figure, numeral 2 designates a two-layer optical disk in which an information recording layer is of a two-layer structure; numeral 11 designates a pit on which information has been recorded; numeral 12 designates a laser diode; numeral 13 designates an objective lens; and numeral 14 designates a focus driving coil of driving the objective lens 13 in vertical direction of the two-layer optical disk 2.

[0004] First, in an initial state of Fig. 7, when a reproduction command of the two-layer optical disk 2 is issued, the laser diode is caused to be emitted (step 1), and thereafter, the focus driving coil 14 is driven to move the objective lens 13 within a predetermined moving range (step 2). At this time, the moving range of the objective lens has been previously set such that the position of the objective lens 13 corresponding to a focus point of a light beam is present within the moving rang.

[0005] Parallel with step 2, a control circuit (its illustration omitted) turns ON a focus servo (step 3). A focus error signal of the first layer (which exhibits a wave form A in Fig. 6, and is compounded from a reproduced RF signal) detected during the movement of the objective lens 13 is monitored to detect whether or not the objective lens 13 has reached a position corresponding to a focus point of the first layer. When a fact that the objective lens 13 has reached a position (point B of Fig. 6) corresponding to a focus point has been detected (step

4, a first layer setting state in Fig. 7), the focus servo of the first layer is started by the use of the focus error signal of the first layer as a control signal (step 5) to perform the data read of the first layer.

[0006] Then, when the data read of a second layer is performed, after the start of the focus servo of the first layer at step 5, a focus jump is performed to a position (point D of Fig. 6) of a focus point of the second layer (step 6, a movement of stroke d of the objective lens 13 in a second layer setting state of Fig. 7), and the focus servo of the second layer is started by the use of the focus error signal (wave form C of Fig. 6) of the second layer as a control signal (step 7) to perform the data read of the second layer (step 8).

[0007]

[Problems to be Solved by the Invention] However, in the method of setting a focus in the above-mentioned conventional two-layer optical disk, when the data read of the second layer is performed, the focus servo of the first layer is started once by the use of the focus error signal of the first layer, and then a focus jump is performed to start the focus servo of the second layer by the use of the focus error signal of the second layer. Hence, as a result, a time has been required until the data read of the second layer.

[0008] Then, in the two-layer optical disk driving device, it has been required that data can be accessed in a short time.

[0009] The present invention has been made to solve the above-mentioned conventional problems and it is an object of the invention to provide a method of setting a focus by which data can be accessed in a short time even in an optical disk driving device of a two-layer optical disk, and provide an optical disk driving device having the method of setting a focus.

[0010]

[Means for Solving the Problems] In order to achieve the object, the composition of the present invention is made such that an object lens is brought close to a two-layer optical disk, and the passing of a first layer of focus point is confirmed by a focus error signal from the first layer, and then a focus servo is turned ON.

[0011] With the composition, the passing of the first layer can be confirmed by the focus error signal of the first layer, and thus, the focus servo of a second layer can be started directly by a focus error signal of the second layer without starting the focus servo of the first layer. As a result, there can be obtained the method of setting a focus by which a time required until the data read of the second layer is shortened, and the optical disk driving device.

[0012]

[Mode for Carrying out the Invention] The invention according to claim 1 of the present invention is a method of setting a

focus of a second optical disk comprising a disk rotating step of rotating a two-layer optical disk in which an optical pit having recording information is provided on the two layers, a surface layer side and an inner layer side by a spindle motor; an information reading step of focusing a laser beam on the two-layer optical disk by a pick up to reproduce the recorded information; and a servo controlling step of performing the servo control of a focus of the pick up on the basis of an output of the information reading step and of performing the servo control of a revolution speed of the spindle motor, wherein the servo controlling step is performed such that after the information reading step detects that a focus point has passed the first layer, the servo control of said focus is turned ON, the method having a function that the focus servo of a second layer can be started directly by a focus error signal of the second layer without performing the focus servo of the first layer.

[0013] The invention according to claim 2 of the present invention is an optical disk driving device comprising a two-layer optical disk in which an optical pit having recording information is provided on the two layers, a surface layer side and an inner layer side; a spindle motor of rotating said two-layer optical disk; a pick up of focusing a laser beam on the two-layer optical disk to reproduce the recorded information and output the information as an RF signal; an RF

signal amplifying means of amplifying said RF signal; a servo means of performing the servo control of the focus of the pick up on the basis of an output of the RF signal amplifying means and of performing the servo control of a revolution speed of the spindle motor; and a controlling means of controlling the entire of the optical disk driving device, wherein the controlling means is performed such that after the pick up detects that a focus point has passed the first layer, the servo control of the focus is turned ON, the device having a function that the focus servo of a second layer can be started directly by a focus error signal of the second layer without performing the focus servo of the first layer.

[0014] Hereinafter, embodiments of the present invention will be explained according to drawings. Fig. 1 (a) is a block diagram of an optical disk driving device in one embodiment of the present invention. Fig. 1 (b) is a detail view of section A of Fig. 1 (a).

[0015] In the figure, an optical disk driving device 1 has a two-layer optical disk 2 of a two-layer structure in which a pit 11 having recording information consists of two layers; a spindle motor 3 of rotating the two-layer optical disk 2; and a focus driving coil 14 of driving an objective lens 13 such that the laser diode 12 caused to emit is focused through the objective lens 13 on the pit 11 having recording information.

[0016] In order to process the read information, the device 1

also has a pick up 4 of reading the recorded information of the rotating two-layer optical disk 2 to output the information as an information signal (RF signal); an RF amplifier section 5 of amplifying the RF signal to output the signal as an RF amplifying signal; a decoder section 6 of converting the RF amplifying signal into a binary signal to separate a frame synchronizing pattern, then performing EFM demodulation and signal processing such as an error correction and the like, and then outputting the signal as a reproduced data from the RF amplifying signal; an interface section 7 of establishing an interface between the optical disk driving device 1 and an external host computer and the like for the reproduced data of the decoder section 6.

[0017] In order to operate the entire of the optical disk driving device 1, the device 1 further has a servo section 8 of performing a focus servo, a tracking servo, a carriage servo and a spindle servo on the basis of the output signals of the RF amplifier section 5 and the decoder section 6; a control section 9 of controlling the entire of the optical disk driving device 1; and a display operation section 10 of performing the input/display of various data on the basis of the control of the control section 9.

[0018] Hereinafter, the focus setting operation of the two-layer optical disk 2 in the optical disk driving device 1 thus composed will be explained according to drawings.

[0019] Fig. 2 is a flowchart showing a method of setting a focus of the two-layer optical disk 2 in one embodiment of the present invention; Fig. 3 is a diagram showing a timing wave form of a focus error signal of Fig. 2; and Fig. 4 is a diagram showing a relationship in position between the two-layer optical disk 2 and the objective lens 13 when a focus is set.

[0020] First, when a reproduction command of the two-layer optical disk 2 is issued by operating the display operation section 10, the control section 9 causes the laser diode 12 provided in the pick up 4 to be emitted (step 1, in an initial state of Fig. 4). Thereafter, a focus actuator (its illustration omitted) is driven by the focus driving coil 14, and thereby the objective lens 13 is caused to be moved within a predetermined distance in the vertical direction with respect to an information recording surface of the two-layer optical disk 2 (step 2). At this time, it is assumed that a previous adjustment is performed such that the focus point of a light beam is present within the movement of the objective lens 13 by the focus actuator.

[0021] At this time, simultaneously, the control section 9 monitors a fist-layer focus error signal (a signal wave form A of Fig. 3) detected during the movement of the objective lens 13, and detects the period of time in which a slice level voltage F for the detection of the fist-layer focus error signal becomes larger than the signal wave form A (step 3).

[0022] Further, it is assumed that a previous setting is preformed such that the slice level voltage F is within the amplitude of the signal wave form A, and is smaller than (a focus servo reference voltage E), that is:

$|F| < |A|$, and

F < Focus servo reference voltage E.

[0023] Thereafter, the focus servo is turned ON at the time when again detecting a point exhibiting:

Signal wave form A > Slice level voltage F for detection of fist-layer focus error signal (step 4).

[0024] Then, when a second-layer focus error signal C (a signal wave form C of Fig. 3) detected during the movement of the objective lens 13 is monitored, and a fact that the objective lens 13 has reached a position corresponding to a focus point of the second layer is detected (step 5, see the point D of Fig. 3 and the second layer setting state of Fig. 4), the focus servo of the second layer is started by the focus error signal C of the second layer as a control signal (step 6), and the data read of the second layer is performed (step 7).

[0025]

[Effects of the Invention] As described above in detail, according to the present embodiment, the object lens 13 is brought close to the two-layer optical disk 2, and a fact that the focus point has passed the first layer is confirmed by the focus error signal of the first layer, and then the focus servo

is turned ON, whereby the focus servo of the second layer can be started directly by the focus error signal of the second layer without performing the focus servo of the first layer, and thus, a time required until the data read of the second layer can be shortened.

[Brief Description of the Drawings]

[Fig. 1] (a) A block diagram of an optical disk driving device in one embodiment of the present invention.

(b) A detail view of section A of Fig. 1(a).

[Fig. 2] A flowchart showing a method of setting a focus of a two-layer optical disk in one embodiment of the present invention.

[Fig. 3] A diagram showing a timing wave form of a focus error signal of Fig. 2.

[Fig. 4] A diagram showing a relationship in position between the two-layer optical disk and an objective lens when a focus is set.

[Fig. 5] A flowchart showing a method of setting a focus in a conventional two-layer optical disk.

[Fig. 6] A diagram showing a timing wave form of a focus error signal.

[Fig. 7] A diagram showing a relationship in position between an optical disk and an objective lens when a focus is set in a conventional two-layer optical disk.

[Description of the Reference Numerals]

1. Optical disk driving device
2. Two-layer optical disk
3. Spindle motor
4. Pick up
5. RF amplifier section
6. Decoder section
7. Interface section
8. Servo section
9. Control section
10. Display operation section
11. Pit
12. Laser diode
13. Objective lens
14. Focus driving coil

Fig. 4

1. Second layer
2. First layer
3. Initial state
4. Lens drive
5. Second layer setting state

Fig. 1

1. RF amplifier section
2. Decoder section
3. Interface section
4. To host computer
5. Servo section [Focus servo Tracking servo Carriage servo Spindle servo]
6. Control section
7. Display operation section
8. Second layer
9. First layer

Fig. 2

10. Reproduction command of two-layer optical disk
11. Laser diode emission
12. Step 1
13. Focus actuator drive
14. First layer focus error signal detection

15. Focus servo ON

16. Second layer focus point detection

17. Second layer focus servo start

18. Second layer data read

Fig 5

19. First layer focus point detection

20. First layer focus servo start

21. Focus jump

Fig. 3

22. A: First layer focus error signal

B: First layer focus point

C: Second layer focus error signal

D: Second layer focus point

E: Focus servo reference voltage

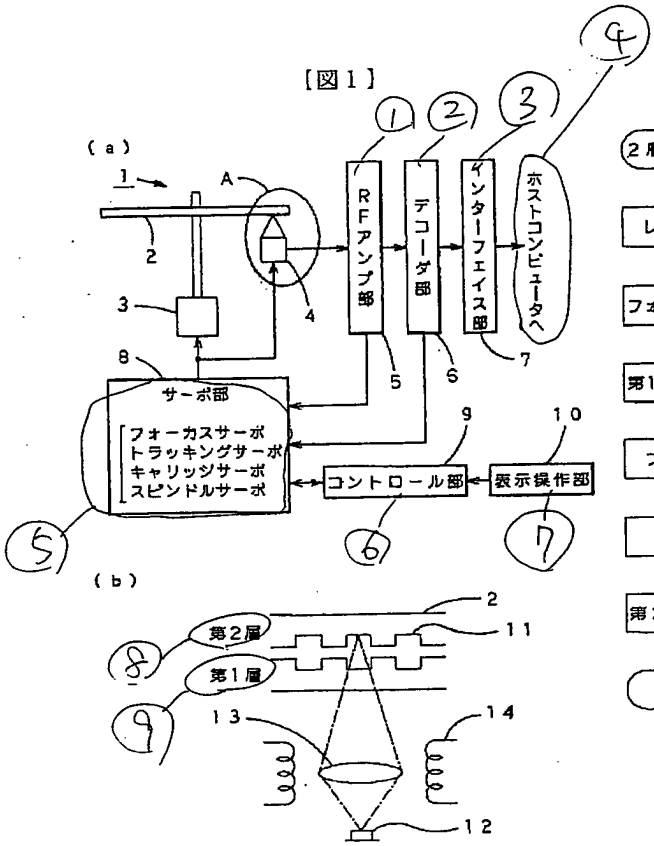
F: Slice level voltage for detection of first layer focus error signal

23. Step 1 through 2

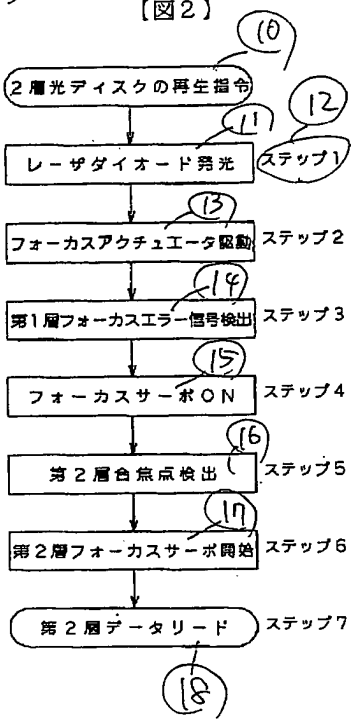
Fig. 7

1. d: Focus jump amount

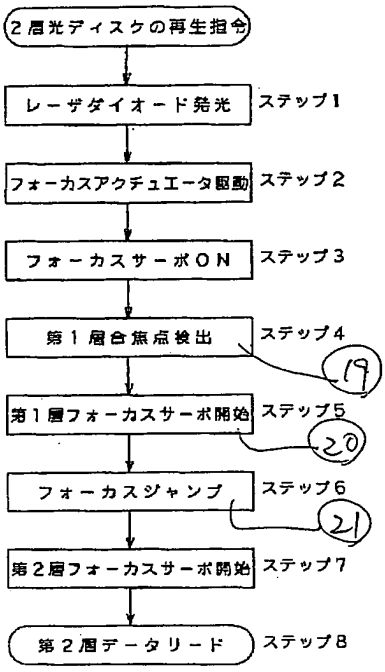
【図1】


(a)
RFアンプ部
デコーダ部
インターフェイス部
ホストコンピュータへ
サーボ部
フォーカスサーボ
トラッキングサーボ
キャリッジサーボ
スピンドルサーボ
コントロール部
表示操作部
(b)
第2層
第1層

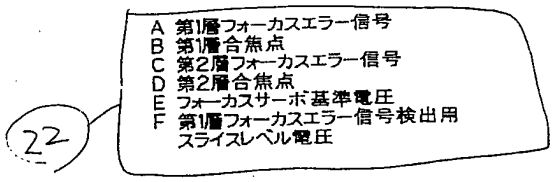
【図2】


2層光ディスクの再生指令
レーザダイオード発光　ステップ1
フォーカスアクチュエータ駆動　ステップ2
第1層フォーカスエラー信号検出　ステップ3
フォーカスサーボON　ステップ4
第2層合焦点検出　ステップ5
第2層フォーカスサーボ開始　ステップ6
第2層データリード　ステップ7

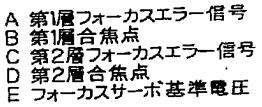
【図5】

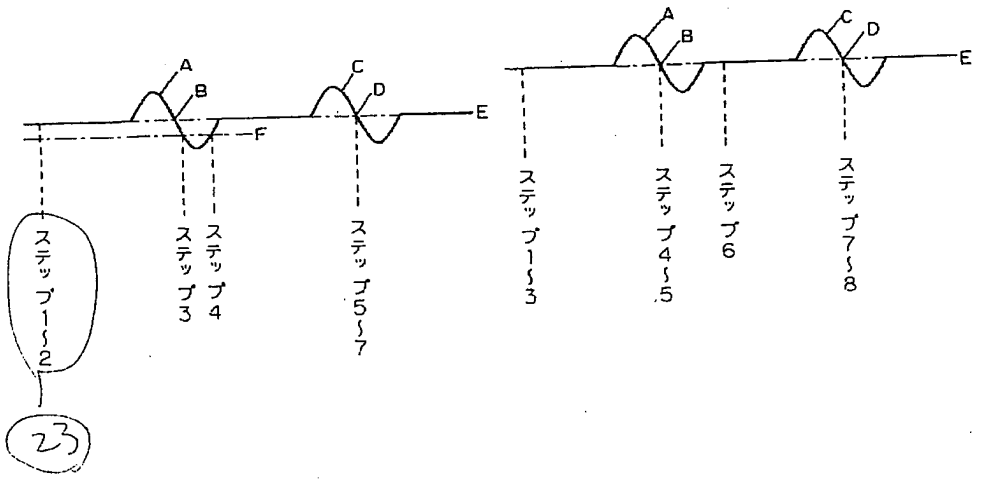

2層光ディスクの再生指令
レーザダイオード発光　ステップ1
フォーカスアクチュエータ駆動　ステップ2
フォーカスサーボON　ステップ3
第1層合焦点検出　ステップ4
第1層フォーカスサーボ開始　ステップ5
フォーカスジャンプ　ステップ6
第2層フォーカスサーボ開始　ステップ7
第2層データリード　ステップ8

【図3】


A 第1層フォーカスエラー信号
B 第1層合焦点
C 第2層フォーカスエラー信号
D 第2層合焦点
E フォーカスサーボ基準電圧
F 第1層フォーカスエラー信号検出用
スライスレベル電圧

【図6】


A 第1層フォーカスエラー信号
B 第1層合焦点
C 第2層フォーカスエラー信号
D 第2層合焦点
E フォーカスサーボ基準電圧


ステップ1～2
ステップ3
ステップ4
ステップ5～7
ステップ1～3
ステップ4～5
ステップ6
ステップ7～8

5

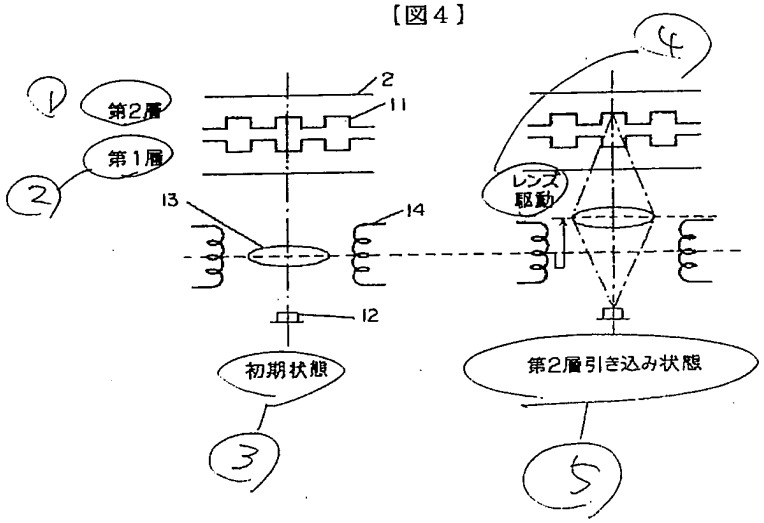
一信号（図３の信号波形Ａ）をモニターし、
第１層フォーカスエラー信号検出用スライスレベル電圧Ｆ＞信号波形Ａ、
となる期間を検出する（ステップ３）。
【００２２】なお、ここで、スライスレベル電圧Ｆは信号波形Ａの振幅内で、かつ、（フォーカスサーボ基準電圧Ｅ）より小、即ち、
｜Ｆ｜＜｜Ａ｜、
Ｆ＜フォーカスサーボ基準電圧Ｅ、
となるように予め設定されているものとする。
【００２３】その後、再び、
信号波形Ａ＞第１層フォーカスエラー信号検出用スライスレベル電圧Ｆ、
となる点を検出した時にフォーカスサーボをオンにする（ステップ４）。
【００２４】次に、対物レンズ１３が移動中に検出する第２層フォーカスエラー信号Ｃをモニターし（図３の信号波形Ｃ）、対物レンズ１３が第２層の合焦点に対応する位置に到達したことを検出すると（ステップ５、図３のＤ点及び図４の第２層引き込み状態を参照）、第２層フォーカスエラー信号Ｃを制御信号として第２層のフォーカスサーボを開始し（ステップ６）、第２層のデータリードを行う（ステップ７）。
【００２５】
【発明の効果】以上に詳細に説明したように、本実施の形態によれば、対物レンズ１３を２層光ディスク２に近づけ、第１層のフォーカスエラー信号により合焦点が第１層を通過したことを確認した後、フォーカスサーボをオンにすることにより、第１層のフォーカスサーボを行うことなく、直接第２層のフォーカスエラー信号により第２層のフォーカスサーボを開始することができるため、第２層のデータリードまでに要する時間を短縮することができる。

6

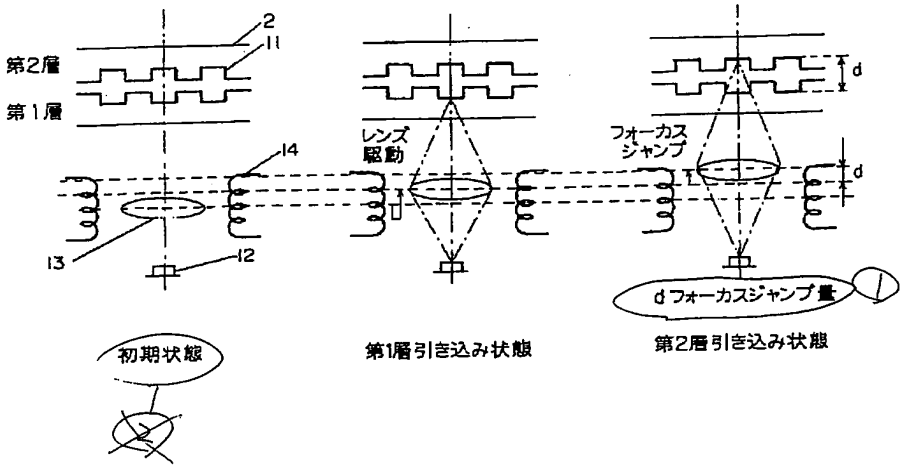
＊【図面の簡単な説明】
【図１】（ａ）本発明の一実施の形態における光ディスクドライブ装置のブロック図
（ｂ）図１（ａ）のＡ部詳細図
【図２】本発明の一実施の形態における２層光ディスクのフォーカス引き込み方法を示すフローチャート
【図３】図２のフォーカスエラー信号のタイミング波形を示す図
【図４】フォーカス引き込み時の２層光ディスクと対物レンズとの位置関係を示す図
【図５】従来の２層構造の光ディスクにおけるフォーカス引き込み方法を示すフローチャート
【図６】フォーカスエラー信号のタイミング波形を表す図
【図７】従来の２層構造の光ディスクにおけるフォーカス引き込み時の光ディスクと対物レンズとの位置関係を示す図
【符号の説明】
１　光ディスクドライブ装置
２　２層光ディスク
３　スピンドルモータ
４　ピックアップ
５　ＲＦアンプ部
６　デコーダ部
７　インターフェイス部
８　サーボ部
９　コントロール部
１０　表示操作部
１１　ピット
１２　レーザダイオード
１３　対物レンズ
１４　フォーカス駆動コイル

＊

【図４】



【図７】


2
11
第2層
第1層
14
13
12
レンズ駆動
フォーカスジャンプ
d
d
d フォーカスジャンプ量
初期状態
第1層引き込み状態
第2層引き込み状態